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Computed Tomography in the Evaluation of Pathological Lesions of Paranasal Sinuses

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ABSTRACT

Background: Computed tomography is now the modality of choice for imaging paranasal sinuses and along with Functional Endoscopic Sinus Surgery has empowered the modern rhinologist to treat patients more effectively. This study aims to evaluate anatomical variation in paranasal sinuses; compare computed tomography with histopathological and surgical findings and establish its diagnostic value.

Methods: A hospital based observational study including all patients referred from the department of Ear, Nose and Throat for computed tomography scan of paranasal sinus to the department of radiology and imaging of Trubhuvan University Teaching Hospital from August 2011 to July 2012. Both axial and coronal sections were evaluated and findings were correlated with surgical findings and histopathology.

Results: A total of 44 patients were included in the study. The most common clinical diagnosis was sinonasal polyposis and chronic rhinosinusitis. Most common anatomical variation was deviated nasal septum (68.2%) followed by choncha bullosa(27%). In most cases more than one sinus was involved. Maxillary sinus was involved in 90.9% followed by ethmoid sinus in 81.8%. Inflammatory pathology was seen in 35 (79.5%) patients with sinonasal polyposis pattern being the most common pattern of involvement. Findings of computed tomography were similar to surgical findings in 84.6% cases. The sensitivity and specificity of computed tomography was fairly good except for fungal rhinosinusitis.

Conclusions: CT scan should be performed preoperatively in order to guide the surgeon for Functional Endoscopic Sinus Surgery or other surgical procedures.

Keywords: Computed tomography; functional endoscopic sinus surgery; paranasal sinus.

INTRODUCTION

The anatomy of nose and paranasal sinuses is complex. This complexity makes difficult for detailed clinical assessment. Plain radiograph is inadequate in evaluation of paranasal sinus and has unacceptably low sensitivity in evaluations of frontal, ethmoidal and sphenoid sinuses.[1] Computed tomography (CT) has replaced plain radiography especially prior to functional endoscopic sinus surgery (FESS) due to anatomical precision required by surgeons. CT in coronal plain simulates the endoscopic surgeon's view of sinonasal cavity.[2] CT has also been found to be superior to magnetic resonance (MR) in planning FESS.[3] Coronal CT has become the investigation of choice in evaluation of pathologies of nose and paranasal sinuses especially in planning FESS.[4] The use of CT scan combined with FESS has empowered the modern rhinologist to treat patients more effectively, facilitating reduced morbidity and complications.

This study aims to evaluate anatomical variation in paranasal sinuses as detected on CT scan and during FESS; compare CT, surgical, and histopathological findings and establish the diagnostic value of CT scan in pathologies of nose and paranasal sinuses.

METHODS

This study was a prospective, observational, hospital based study conducted in the Department of Radiodiagnosis & Imaging, and Department of Ear, Nose and Throat (ENT) of Trubhuvan University Teaching

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Hospital(TUTH). The study was conducted during the period of one year from August 2011 to July 2012. Ethical approval was taken from the institutional review board. Written consent was taken from patients for inclusion in the study.

All patients who were evaluated in the department of ENT, and sent for CT scan of paranasal sinuses in department of radiolodiagnosis and imaging, were included in the study. Patient evaluated elsewhere; patients who did not undergo FESS or other surgical procedure in TUTH and patients of facial trauma were excluded from the study.

The study group comprised a total of 44 patients. CT scan of the nose and PNS was performed in coronal and axial planes with standard protocol of PNS. CT scans were first evaluated by residents and findings were confirmed by radiologists. Patients' surgical findings and histo-pathological findings were followed up and evaluated.

Statistical analysis was done by using SPSS version 17.0. Data were presented as numbers and percentage for nominal data and in means and standard deviation for numerical values. The sensitivity and specificity for CT findings were calculated and chi square test was used to find significance. Level of significance was considered at p- value of <0.05.

RESULTS

A total of 44 patients were included in the study with a mean age of 40.0±17.3 yrs (Range 71-14 yrs.). Male to female ratio was 1.9:1 with 29(65.9%) male and 15(34.1%) female. Main complains of patients attending ENT OPD were nasal obstruction (39; 88.6%), nasal discharge (18; 40.9%) and headache (11; 25%). Most common clinical diagnosis in these patients was sinonasal polyp (20; 45.5%) followed by chronic rhinosinusitis (11; 25.0%).

Table 1. CT findings of anatomical variants in paranasal sinuses.

CT Findings	Number of cases (Percent) N=44
Deviated Nasal Septum	30(68.2)
Left	16(36.4)
Right	14(31.8)
Concha Bullosa	12(27.3)
Left	6(13.6)
Right	4(9.09)
Bilateral	2(4.5)
Ostiomeatal complex Obstruction	35(79.5)
Left	8(18.2)
Right	5(11.4)
Bilateral	22(50.0)

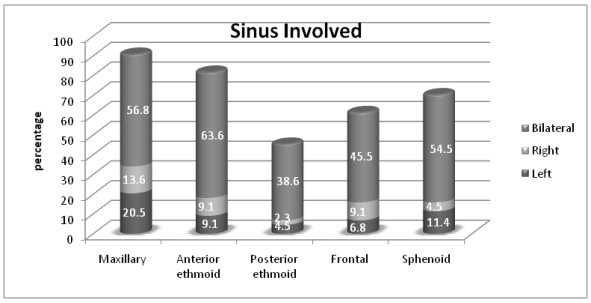

Figure 1. Distribution of Sinuses affected.

Anatomical variation: Deviated nasal septum was present in 30(68.2%) patients among which deviation towards left side was in 16(36%) while deviation in right side was 14 (31.8%). Choncha bullosa was present in 12(27.0%) patients, involving left side in 6(13.6%), right side in 4(9.0%) and bilateral in 2(4.5%) cases. Obstruction to ostiomeatal complex was found in 35(80.0%) patients, among whom 22(50.0%) patients had bilateral involvement, 8(18.2%) left side and 5(11.4%) had right side involvement. (Table 1)

Table 2. Diagnosis made on the basis of CT scan findings.

Diagnosis by CT scan Findings	Number of cases (Percentage)
Sinonasal Polyposis	29(65.9)
CRS	3(6.8)
Inverted pappiloma	7(15.9)
Fungal sinusitis	2(4.6)
Others	4(9.1)

Sinuses involved: Out of the 44 patients one patient did not have sinus involvement. The patient was evaluated for nasal mass, which was diagnosed as malignant nasal mass by CT scan with wide local extension and bone destruction so only an incisional biopsy was done and a diagnosed of malignant melanoma was made histopathology. The patient was later referred for radiotherapy. One patient had involvement of only one (left maxillary) sinus. Rest of the patients had involvement of two or more sinuses. Maxillary sinus was the most commonly involved sinus (40; 90.9%) followed by anterior ethmoidal sinus (36; 81.8%). (Figure 1) Diagnosis was made on the basis of CT findings among which sinonasal polyposis was the most common. (Table

2)

Table 3. Pattern of involvement in inflammatory diseases of paranasal sinuses

Inflammatory Pattern	Number of cases (percent)
Sino nasal polyposis	19 (54.3)
Non specific	8 (22.9)
Ostiomeatal complex	5 (14.3)
Infundibular	3 (8.6)
Spheno ethmoid recess pattern	1 (2.9)

Pattern of Inflammation: Inflammatory lesions were seen in 35 patients on CT scan. These lesions were classified into various patterns described by Sonkens et al.[5] Among the inflammatory lesions sinonasal polyposis (SNP) was the most common pattern of inflammation (19/35; 54.0%). The sphenoethmoid recess pattern was the least common, which was seen in only one patient in combination with ostiomeatal unit pattern (Table-3).

Table 4. Diagnosis on the basis of surgical findings (FESS or Other surgical procedures).

Surgical Findings	Number of cases (percentage)
Sinonasal Polyposis	25(56.8)
Chronic Rhinosinusitis	2(4.5)
Inverted pappiloma	6(13.6)
Fungal sinusitis	4(9.1)
Others	7(15.9)

Bone Involvement: Bone involvement was seen in 5(11.4%) patients in CT, which was confirmed during surgical procedure.

Table 5. Histopathological Diagnosis.

Histopatology Diagnosis	Number(n=26)	Percent
Inflammatory polyp	9	34.6
Inverted Papilloma	6	23.1
Fungal sinusitis/polyposis	4	15.4
Nasopharyngeal angiofibroma	3	11.5
Non specific inflammation	1	3.8
Ameloblastoma	1	3.8
Malignant melanoma	1	3.8
Rhinosporidiosis	1	3.8
Total	26	100

All anatomical variations identified in CT were found to correlate during FESS or other form of surgery. Bone involvement detected by CT was noticed in all cases during surgical procedure. Out of 44 patients only 26(59.1%) patients were subjected to hisotpathologic examination. The most common diagnosis on surgical findings was sinonasal polyposis. (Table 4) Two cases were diagnosed as malignant mass by surgical findings, which proved to be ameloblastoma and malignant melanoma on histopathology. One case diagnosed as inflammatory polyposis was found to be rhinosporidiosis on histopathology. Rest of the surgical findings was correlated with histopathological diagnosis. Inflammatory polyp was found to be the most common (9/26; 34.6%) histopathologic diagnosis followed by inverted papilloma, fungal sinusitis and nasopharyngeal angiofibroma (Table 5). Final diagnosis was made only after surgical diagnosis followed by histopathology confirmation (Figure 2).

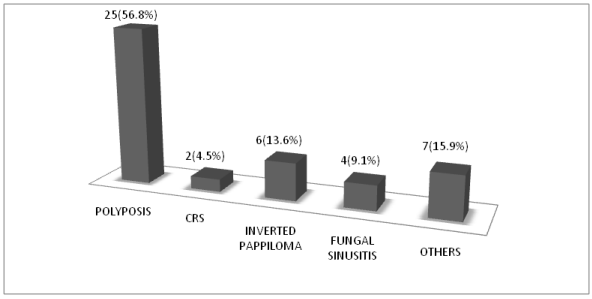

Figure 2. Final diagnosis after FESS and Histopathology

Comparision of CT findings with final diagnosis

Table 6. Correlation of CT and Final Diagnosis.

Diagnosis	CT Number of cases (Percentage)	Final Diagnosis Number of cases (percentage)
Sinonasal Polyposis	28(63.6)	25(56.8)
Chronic Rhinosinusitis	3(6.8)	2(4.5)
Inverted pappiloma	7(15.9)	6(13.6)
Fungal sinusitis	2(4.6)	4(9.1)
Others	4(9.1)	7(15.9)

CT diagnosis correlated with surgical diagnosis in 84.6% cases, which also had significant association with final diagnosis. (Table 6) CT diagnosis and final diagnosis demonstrated statistical significant association in chi square test. (Table 7)

CT as a diagnostic test in various paranasal sinus pathologies:

The sensitivity and specificity of CT scan in diagnosis of nose and paranasal sinus diseasesare high except in fungal sinusitis. Nasal polyp had sensitivity of 88% and

Table 7. Sensitivity and specificity of CT Diagnosis with chi square test.

Parameter	Sensitivity	Specificity	PPV	NPV	Accuracy	P-value
Polyposis	62.5	80.0	78.95	64.0	70.45	0.005
Chronic rhinosinusitis	50	76.19	9.09	96.97	75	0.40
Inverted pappiloma	50	97.36	75	92.5	90.90	<0.001

PPV- positive predictive value, NPV- negative predictive value; P-value from chisquare test

specificity of 74% whereas CRS had sensitivity of 100% and specificity of 97%. Likewise inverted papilloma had sensitivity of 84% and specificity of 94% whereas fungal sinusitis had low sensitivity of 25% and high specificity of 97% (Table 7).

DISCUSSION

Diseases of paranasal sinuses are often found in the presence of anatomical variation such as a deviated nasal septum, concha bullosa or a large agger nasi cell, but these anatomical variations are common findings in normal people. Few studies shows that there is no consistent difference in the prevalence of anatomical variations between symptomatic group and control group, with the possible exception of a septal deviation.[6] The prevalance of deviated nasal septum in our study is quite high (68%) as compared to studies done by Maru et al. and Dua et al. in India. [7, 8] The high prevalence in our study might be due to geographic variation. In Nepal, Badhu B et al. found that deviated nasal septum was found in 55 % of patients with associated nasal diseases which was 14% of all patients during dacryocystorhinostomy.[9] This shows that prevalence of deviated nasal septum is high among patients with nasal disease than normal population.

Chonca bullosa if large can cause nasal obstruction and headache on its own without associated nasal pathologies.[10] In our study chonca bullosa was found in 27% of the population. The prevalence of chonca bullosa in various range from 14 -53%, however the relationship of concha bullosa to paranasal sinus disease continues to be debated.[6, 11]

Abnormality and blockage of the ostiomeatal complex is the key factor for the causation of chronic rinosinusitis and other related pathologies of paranasal sinuses. The basic principle of FESS is to remove these blockage to facilitate normal physiological clearance of mucus from the sinuses and to facilitate good aeration into the paranasal sinuses.[6, 10] In our study abnormality in choncha bullosa was associated in 80% of cases which is similar to results of Dua et al.

The most common clinical diagnosis for which CT scan was advised was sinonasal polyposis (45.5%) which was also the most common CT diagnosis as well as final diagnosis. The results are consistent with other studies which also revealed sino nasal polyposis to be a common conditions encountered on clinical, CT and surgical findings. However chronic rhino sinusitis was not a very common diagnosis in our study which was a common diagnosis on CT and surgical findings in other studies.[12, 13] The reason for less number of chronic rhino sinusitis found in our study might be due to the practice of treating chronic rhino sinusitis on the basis of clinical and plain radiography findings by locally available health professionals in our country. Another reason could be less number of patient undergoing operative management for chronic rhinosinusitis in Nepal.

Our study showed good correlation of CT findings with surgical findings. The anatomical findings in CT were correlated in 100% cases. Singhal et al also showed high correlation of CT findings and surgical findings like deviated nasal septum 83%; choncha bullosa 88% and ostiomeatal complex involvement in 87%.[13] CT scan also showed 100% correlation with surgical findings for bone involvement which was also 100% in study done by Singhal et al.[13]

CT showed good correlation with surgical diagnosis. CT diagnosis was correlated with surgical diagnosis in 84.6% cases. The correlation is however lower as compared to study done by Singhal et al.[13] Strong positive correlation was seen with chronic rhinosinusitis while poor correlation was seen with fungal sinusitis. However all diagnosis had positive correlation with surgical findings. These results are similar to results observed by singhal et al and Danielsen et al who also demonstrated good correlation between CT and surgical findings for polyposis and mucosal thickening; however they did not take into consideration diagnosis made on the basis of CT and surgical findings.[12, 13] In contrast some study observed CT findings did not correlate with surgical or histopathologic findings.[6] The lack of correlation was seen in studies done prior to multislice CT scan.

The sensitivity and specificity of CT is high for all diagnosis except for fungal sinusitis. The results suggest that CT is a good diagnostic tool for identification of pathologies in paranasal sinuses, although the sensitivity for fungal sinusitis is low.

There were some limitations to this study. All anatomical

variations of paranasal sinuses like agar nasi cells, Haller cells , Onodi cells were not studied. The studies of anatomical variations were not compared to patients without nasal complains to identify their relations to sino nasal pathologies. The sample size of the study was also small.

CONCLUSIONS

CT scan is a good investigation tool to identify anatomy, pathology and extent of disease in pathologies of paranasal sinuses with reasonably good sensitivity and specificity for the diagnosis. It also depicts the anatomical variation in paranasal sinus alerting surgeon about the possible complication and also aids in preoperative planning. Thus CT scan should be performed preoperatively in order to guide the surgeon for FESS or other surgical procedures.

REFERENCES

1. Aaløkken T, Hagtvedt T, Dalen I, Kolbenstvedt A. Conventional sinus radiography compared with CT in the diagnosis of acute sinusitis. Dentomaxillofacial Radiology. 2003;32(1):60-2.
2. Yousem DM. Imaging of sinonasal inflammatory disease. Radiology. 1993;188(2):303-14.
3. Hähnel S, Ertl-Wagner B, Tasman A-J, Forsting M, Jansen O. Relative Value of MR Imaging as Compared with CT in the Diagnosis of Inflammatory Paranasal Sinus Disease. Radiology. 1999;210(1):171-6.
4. Mafee MF, Chow JM, Meyers R. Functional endoscopic sinus surgery: anatomy, CT screening, indications, and complications. American Journal of Roentgenology. 1993;160(4):735-44.
5. Sonkens JW, Harnsberger HR, Blanch GM, Babbel RW, Hunt S. The impact of screening sinus CT on the planning of functional endoscopic sinus surgery. Otolaryngology--Head and Neck Surgery. 1991;105(6):802-13.
6. Jones NS. CT of the paranasal sinuses: a review of the correlation with clinical, surgical and histopathological findings. Clinical Otolaryngology & Allied Sciences. 2002;27(1):11-7.
7. Maru YK, Gupta V. Anatomic variations of the bone in sinonasal C.T. Indian journal of otolaryngology and head and neck surgery : official publication of the Association of Otolaryngologists of India. 2001;53(2):123-8.
8. Dua K, Chopra H, Khurana A, Munjal M. CT scan variations in chronic sinusitis. Indian Journal of Radiology and Imaging. 2005;15(3):315.
9. Badhu B, Dulal S, Kumar S, Thakur S, Sood A, Das H. Epidemiology of chronic dacryocystitis and success rate of external dacryocystorhinostomy in Nepal. Orbit. 2005;24(2):79-82.
10. Kantarci M, Karasen RM, Alper F, Onbas O, Okur A, Karaman A. Remarkable anatomic variations in paranasal sinus region and their clinical importance. European journal of radiology. 2004;50(3):296-302.
11. Lloyd G. CT of the paranasal sinuses: study of a control series in relation to endoscopic sinus surgery. The Journal of Laryngology & Otology. 1990;104(06):477-81.
12. Danielsen A, Reitan E, Olofsson J. The role of computed tomography in endoscopic sinus surgery: a review of 10 years' practice. Eur Arch Otorhinolaryngol. 2006;263(4):381-9.
13. Singhal P, Sonkhya N, Mishra P, Srivastava S. Impact of Anatomical and Radiological Findings for Consideration of Functional Endoscopic Sinus Surgery. Indian Journal of Otolaryngology and Head & Neck Surgery. 2012;64(4):382-5.